

**VERIFICATION OF TRANSLATION**

I, So Min LEE, a citizen of Republic of Korea, residing at 1<sup>st</sup> Floor, Dowon Bldg., 1059-11 Namhyun-dong, Kwanak-gu, Seoul 151-800, Republic of Korea hereby declare:

That I am knowledgeable in the English language and in the Korean language;


That I can translate from Korean into English;

That the English Translations attached hereto are true and complete translation of the Korean language priority document of KR application no. 10-1999-0000603, and

That all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that such willful false statements made will jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

May 19, 2009  
Date

  
Signature

So Min LEE  
Typed or printed name

## **ABSTRACT**

A method for creating and recording management information for recording digital data streams as stream objects on a recording medium such as a digital video disc, or deleting or editing recorded digital data streams. The method records a received digital data stream by grouping the received digital data stream into a stream object, and records identification information for identifying the location on time search information for said stream object. the present invention enables rapid and precise search of a specific interval of the recorded digital data, by searching digital data stream using identification information upon recording received digital data streams on a recording medium as groups of stream objects or deleting a part of the recorded digital data streams from the recording medium.

## **SPECIFICATION**

### **Title**

**METHOD FOR RECORDING SEARCH INFORMATION FOR RECORDED DIGITAL DATA**

**STREAMS AND SEARCH METHOD USING THE SEARCH INFORMATION**

### Brief Description Of The Drawings

FIG. 1 is a block diagram of an apparatus in which a method for generating and recording management information of recorded digital data streams according to the present invention may be employed;

FIG. 2 is the syntax of the management information created by the method for creating management information for recorded digital data streams in accordance with the present invention;

FIG. 3 is a pictorial representation of the stream time map information as a part of the management information created by the method for creating management information for recorded digital data streams in accordance with the present invention;

FIG. 4 is a pictorial representation for explaining the digital data stream recording operation in accordance with the present invention;

FIG. 5 is a pictorial representation for explaining the management information created by the method for creating management information for recorded digital data streams in accordance with the present invention;

FIG. 6 is the syntax of the management information created upon deleting a part of recorded digital data stream;

FIG. 7 is a pictorial representation for explaining

a method of creating and recording management information according to the present invention for recorded digital data stream upon deleting a part of the recorded digital data stream; and

FIG. 8 is a pictorial representation for explaining management information updated by the method of creating and recording management information of recorded digital data stream upon deleting a part of the recorded digital data stream.

#### Major Elements In Drawings

100: set top box  
110 : tuning unit  
120 : decoder  
130,210 : communication interface  
140,250 : control unit  
150, 260 : memory  
200 : streamer  
220 : stream recording unit  
230 : recording medium (DVD)  
240 : stream reproducing unit

#### Background Of The Invention

The present invention relates to a method for cre-

ating search information for searching digital data streams recorded on a recording medium and a method for searching for requested data using the search information.

In the conventional analog television broadcast, video signals are transmitted over the air or through cables after being AM or FM modulated. With the recent advance of digital technologies such as digital image compression or digital modulation/demodulation, standardization for digital television broadcast is in rapid progress. Based upon the Moving Picture Experts Group (MPEG) format, satellite and cable broadcast industry also moves towards the digital broadcast.

The digital broadcast offers several advantages that its analog counterpart cannot provide. For example, the digital broadcast is capable of providing services with far more improved video/audio quality, transmitting several different programs within a fixed bandwidth, and offering enhanced compatibility with digital communication media or digital storage media.

In the digital broadcast, a plurality of programs encoded based upon the MPEG format are multiplexed into a single transport stream before transmitted. The transmitted transport stream is received by a set top box at the receiver and demultiplexed into original

programs. If a program is chosen from among the demultiplexed programs, the chosen program is decoded by a decoder in the set top box and original audio and video signals are retrieved. The retrieved audio and video signals can be presented by an A/V output apparatus such as a TV.

It is also possible to record the received digital broadcast signals on a storage medium instead of directly outputting the received broadcast signals to A/V output devices. The stored digital broadcast signals can be edited and retrieved afterwards. For example, a digital data stream received by the set top box can be transmitted to a streamer such as a digital video disk (DVD) recording apparatus through communication interfaces like an IEEE-1394 serial bus and stored in the streamer. The stored digital data stream can be edited and transmitted back to the set top box so that the digital audio and video data can be presented.

For recording a received digital broadcast stream on a recording medium, it is necessary to develop schemes to organize the digital data stream on the recording medium and to create management information for rapid access to the recorded data stream.

### Explanation Of The Invention

It is an object of the present invention to provide a method of creating and recording management information of recorded digital data stream by recording received digital data streams on a recording medium as groups of stream objects and creating search information for each stream object.

It is another object of the present invention to provide a method of creating and recording management information of recorded digital data stream by updating time search information of recorded digital data streams to search the data stream recorded on a recording medium such a digital video disc corresponding to time requested to search.

It is yet another object of the present invention to provide a method of creating and recording management information of recorded digital data stream by deleting a part of recorded stream object units from recorded digital data stream on a on a recording medium such a digital video disc and updating time search information of the deleted digital data stream.

According to the present invention, it is provided a method for creating and recording management infor-

mation for recorded digital data streams, comprising the steps of recording a received digital data stream by grouping the received digital data stream into a stream object; and recording identification information for identifying the location on time search information for said stream object.

Further, it is provided a method for creating and recording management information for recorded digital data streams, comprising the steps of deleting a part of recorded digital data stream from stream object; dividing the stream object into a plurality of stream objects before and after the deleted part of the data stream; and recording identification information for identifying the locations on time search information for said divided stream objects.

Further, it is provided a method for creating and recording management information, comprising the steps of selecting a stream object corresponding to a requested location on time for searching the requested location from recorded single program; reading the location on time search information for searching the selected stream object; and searching the requested location on time from recorded data stream based on start time information of the selected stream object and time length data from the read location on the



time search information.

It is provided a method for creating and recording management information for recorded digital data streams, comprising the steps of deleting a part of stream object units from recorded stream object of digital data stream; selecting an entry of time search information including time lengths of the deleted stream object units; and dividing the selected entry and updating the time search information.

In order that the invention may be fully understood, preferred embodiments thereof will now be described with reference to the accompanying drawings.

FIG. 1 depicts a block diagram of an apparatus in which the present invention may be advantageously employed. The apparatus comprises a set top box 100, a communication interface (IEEE-1394), and a streamer 200.

The set top box 100 receives transport streams encoded by system encoders and broadcast by a plurality of broadcasting stations and demultiplexes the received transport streams. After a system decoder 120 decodes the transport stream of a program tuned by a tuning unit 110, a control unit 140 outputs the decoded transport stream to an A/V output device such as

a TV set for presentation.

The set top box 100 may transmit a program chosen by a user to the streamer 200 through the IEEE-1394 interface so that the transmitted program is recorded on a recording medium 230 such as a digital video disk by the streamer 200.

Requested by a user, the set top box 100 may receive a program retrieved from the recording medium 230 by the streamer 200 through the IEEE-1394 communication interface so that the received program can be presented on a TV set after being decoded by the decoder 120.

For carrying out these tasks, the set top box 100 and the streamer 200 should be able to access the management information regarding the programs recorded on the recording medium 230. To this end, information files are used to deal with the recorded data. An application information file is utilized by the set top box 100 and a streamer information file is utilized by the streamer 200. A common information file is utilized by both the set top box 100 and the streamer 200. These information files are recorded on the recording medium 230.

The application information file is retrieved by a stream reproducing unit 240 of the streamer 200 when

the set top box 100 is initialized or requests the file. The retrieved application information is transmitted to the set top box 100 through the IEEE-1394 communication interface and loaded into the management information area M2 of a memory 150 by a control unit 140 of the set top box 100. When a new program is recorded or recorded data is edited, the application information loaded in the memory 150 is updated by the control unit 140 to include management information on the newly recorded or edited program. If a user requests retrieval of a specific program, the control unit 140 requests the streamer 200 to retrieve the program, with reference to the application information. When the set top box 100 terminates a recording mode or is shut down, the application information in the memory 150 is transmitted through the IEEE-1394 communication interface to the streamer 200 and recorded on the recording medium 230 by a stream recording unit 220 controlled by a control unit 250 of the streamer 200.

The streamer information file and common information file are retrieved by the stream reproducing unit 240 of the streamer 200 when the streamer 200 is initialized and loaded into a memory 260 by the control unit 250 of the streamer 200. When a new program is

recorded or recorded data is edited, the streamer and common information is updated to include management information on the newly recorded or edited program by the control unit 250. If a user requests retrieval of a specific program, the control unit 250 responsive to a request signal from the set top box 100 retrieves the associated program recorded on the recording medium 230 with reference to the streamer and common information loaded in the memory 260. When the set top box 100 terminates a recording mode or is shut down, the streamer and common information in the memory 260 are recorded on the recording medium 230 by the stream recording unit 220 controlled by the control unit 250.

The syntax of the information files and the structure of recorded data will be explained with reference to FIG. 2.

As shown in FIG. 2, the application information file (application.IFO) comprises a table of content (TOC) and a service information (SI) table. The table of content (TOC) contains random-access entry points that allow random access to the recorded data stream and the service information (SI) table contains the information on the recorded digital stream. The common information file (common.IFO) contains an original playlist automatically created when a digital data

stream is recorded, presentation sequence information (Cell) of the recorded data stream, and a user-defined playlist created when a user edits the presentation sequence of the recorded data stream.

The streamer information file (streamer.IFO) is intended to deal with stream time map general information (STMAP\_GI) and a mapping list (MAPL). The stream time map general information (STMAP\_GI) is management information regarding stream object units (SOBUs) organized on the recording medium and stream objects (SOBs) each of which comprises a plurality of stream object units (SOBUs) and the mapping list (MAPL) is time search information regarding the stream object units (SOBUs) and stream objects (SOBs). Each stream object (SOB) has a one-to-one correspondence with each Cell contained in the original playlist and each Cell is contained in the user-defined playlist and has a one-to-one correspondence with each stream object (SOB).

The stream time map general information (STMAP\_GI), as shown in FIG. 3, comprises several fields representing the stream object unit size (MAPU\_SZ), the weight of the LSB of the mapping list entries (MTU\_SHFT), index number (INDEX\_NO) indicating an arbitrary entry of the mapping list (MAPL), the number

of mapping list entries (MAPL\_ENT\_Ns), start packet arrival time (S\_SAPAT), and last packet arrival time (S\_E\_APAT). The mapping list (MAPL) comprises mapping entries (MAPU\_ENT), each mapping entry containing the incremental application packet time (IAPAT).

The method for creating and recording search information for recorded digital data streams in accordance with an embodiment of the present invention will be explained with reference to FIGS. 1, 2, and 3. If a user asks for recording a received digital data stream on the recording medium 230, the control unit 140 of the set top box 100 notifies the control unit 250 of the streamer 200 that a recording mode has been set and begins to transmit the received digital data stream to the streamer 200 through the IEEE-1394 interface. Concurrently, the control unit 140 of the set top box 100 records the entry point information that allows random access to the transport stream packets of the digital data stream in the application information (application.IFO) loaded in the management information area (M2) of the memory 150 or records the entry point information in the common information (common.IFO) as a part of the playlist. Also, the control unit 140 detects the information on the data stream currently being recorded from the program service in-

formation (SI) loaded in the program information area (M1) of the memory 150 and records the service information in the service information (SI) table of the application information (application.IFO).

The control unit 250 of the streamer 200 controls the stream recording unit 220 so that the data stream received through the IEEE-1394 communication interface is recorded on the recording medium 230. The data stream is organized in sectors on the recording medium 230 and a predetermined number of sectors constitute a stream object unit (SOBU). Such process is repeated until the recording mode terminates, thereby creating a stream object (SOB) which is a group of data stream recorded by a single recording operation.

The control unit 250 of the streamer 200 creates presentation sequence information (Cell) regarding the created stream object (SOB) and records the Cell in the Cell layer of the common information (common.IFO) as presentation sequence information corresponding to the record (RCD) of the original playlist. For searching for stream object units (SOBUs) constituting the stream object (SOB), the time length of every stream object unit (SOBU) is sequentially recorded in the mapping list (MAPL). To be more specific, a count value counted at a constant time interval while a stream

object unit (SOBU) is created, namely, the incremental application packet time (IAPAT) is recorded in the mapping entry field (MAPU\_ENT) corresponding to the associated stream object unit (SOBU), as shown in FIGS. 4 and 5. In addition, the sum of a predetermined number of incremental application packet times (IAPATs) (the numbers parenthesized in FIG. 5) is calculated and the sum is recorded as a coarse mapping entry (C\_MAP\_ENT) which is coarse search time information.

The index number (INDEX\_NO) of the first mapping entry (MAPU\_ENT) of the mapping list (MAPL) or the first coarse mapping entry (C\_MAPU\_ENT) associated with the stream object (SOB) is recorded in the stream time map general information (STMAP\_GI). In FIG. 5, the index number K of the first mapping entry related to the stream object SOB #n is recorded as identification information for indexing the location of the stream object SOB #n.

If a user requests retrieval of a certain interval of a data stream recorded on the recording medium, for example recorded data corresponding to the time interval from 10 minutes to 20 minutes, the control unit 150 of the streamer 200 first searches Cells for a Cell (Cell 2 in FIG. 2) having a recording time corresponding to the start time 10 minutes. Then, the con-



trol unit 150 detects the index number pointing to the start position of the stream object SOB 2 corresponding to the chosen Cell Cell 2 from the stream time map general information (STMAP\_GI). Subsequently, the control unit 150 begins to detect the incremental application packet times (IAPATs), starting from the mapping entry pointed to by the index number. By summing the detected incremental application packet times (IAPATs) and multiplying the sum value by the unit time of each count, the start position of the stream object unit (SOBU) corresponding to the requested search time 10 minutes can be found. Finally, data retrieval begins from the transport stream packet whose packet arrival time coincides with the requested time.

If a user requests retrieval of the recorded data corresponding to the time interval from 40 minutes to 60 minutes and the Cell having a recording time corresponding to the requested time 40 minutes is Cell 3, the control unit 150 detects the index number pointing to the start position of the stream object SOB 3 corresponding to the chosen Cell Cell 3 from the stream time map general information (STMAP\_GI). Subsequently, the control unit 150 begins to detect the incremental application packet times (IAPATs) listed in the mapping list MAPL 3. By summing the detected incremental

application packet times (IAPATs) and multiplying the sum value by the unit time of each count, the start position of the stream object unit (SOBU) corresponding to the requested time 40 minutes can be found. Finally, data retrieval begins from the transport stream packet whose packet arrival time coincides with the requested time.

Hereinbelow, preferred embodiments of a method for creating and recording management information according to deleting of a part of data stream from single stream object will be described with reference to the accompanying drawings.

At first, if a request to delete a part of data stream from the recorded stream object is entered by a user, the control unit 250 of the streamer 200 selects a stream object corresponding to requested time to delete by searching presentation sequence information (Cell) having recoding start time information and recording end time information to select the stream object to be requested to delete as described above. As shown in FIG. 6, if the selected stream object is SOB1 and deleted interval is a part of SOB1, the control unit 250 deletes data stream between deletion start location  $d\_start$  and deletion end location  $d\_end$  by stream object units. That is, SOBU  $M+3$  and SOBU  $M+4$

are deleted and SOB1 is divided into two stream objects SOB1\_A and SOB1\_B with reference to the deleted stream object units SOBU M+3 and SOBU M+4.

Accordingly, information such as a mapping list MAPL1 and presentation sequence information Cell 1 of the stream object SOB1 existed before the above deletion is updated. This updated management information includes recording start time information start\_time recorded in Cell 1, recording end time information end-time and presentation sequence information in one-to-one correspondence with the stream object as shown in FIG. 6, that is, Cell 1 is divided into Cell 1\_A and Cell 1\_B. For example, assuming that time information of Cell 1 is 0-1 hr (hour) and deleted time is 20 to 30 minutes, time information of Cell 1\_A is 0-20 min (minutes) and time information of Cell 1\_B is 30 min-1 hr.

Furthermore, the mapping list MAPL is divided and managed for each divided stream objects SOB1\_A and SOB1\_B. A mapping list MAPL 1\_A corresponding to SOB1\_A uses mapping entries up to MAPU\_ENT #M+3 corresponding to stream object units before the deleted stream object units SOBU M+3 as time search information, and a mapping list MAPL 1\_B uses mapping entries starting from MAPU\_ENT #M+5 corresponding to stream

object units after the deleted stream object units SOBU M+3 SOBU M+4 as search time information. Specifically, the mapping entry information MAPU\_ENT\_M+5 may be practically updated and managed by MAPU\_ENT\_M+3. Identification information for identifying first mapping entry information of MAPL 1\_B corresponding to SOB 1\_B is additionally recorded as index number INDEX\_NO on the above stream time map general management information STMAP\_G1. Alternatively, the incremental application packet time (IAPAT) accumulated before the divided MAPL 1\_B may be additionally recorded thereon.

Further, as shown in FIG. 8, as SOB\_1 is divided into SOB 1\_A and SOB 1\_B, so a coarse mapping entry information C\_MAP\_ENT # M which is coarse search time information created before the division is divided into C\_MAP\_ENT # M1\_A and C\_MAP\_ENT # M1\_B. If the coarse search time information C\_MAP\_ENT # M which is incremental application packet time information calculated by summing incremental application packet time information recorded in a plurality of mapping entry information MAPU\_ENT, for example, incremental packet time information summed before the division of C\_MAP\_ENT # M1\_A and C\_MAP\_ENT # M1\_B, is '30' and incremental packet time information of the deleted mapping entries MAPU\_ENT # M+3 and MAPU\_ENT # M+4 are 4

and 3, respectively, then 7 is deleted according to the division, and accordingly created C\_MAP\_ENT # M1\_A and C\_MAP\_ENT # M1\_B stores summed incremental packet time information 7 and 16, respectively.

As described above, if the index number INDEX\_NO which is identification information corresponding to recorded or divided stream object is not additionally recorded during the recording or deleting operation, in order to search the location of the recorded data stream, incremental packet time information IAPAT recorded on the mapping list MAPL has to be sequentially summed up, and the summed incremental packet time information IAPAT has to be multiplied by a unit time to search an approximate location of the data stream, thereafter transport packets of stream object units of the data stream at the searched location have to be sequentially decoded to detect and reproduce transport packet corresponding to the time requested to be reproduced. Therefore, search time may be delayed.

Furthermore, if a great deal of data stream is deleted during the deleting operation, then the optical pick-up has to perform track jump to move a quite distance for reading the data stream, therefore, search time delay gets worse. Further, if a first search location is calculated as a location after the transport

packet of the data stream requested to be reproduced, then the transport packet requested to be reproduced cannot be detected even if transport packets are sequentially decoded as described above, whereby the reproduction is stopped.

Therefore, according to the present invention, if a time to delete an interval from the data stream recorded on the recording medium is entered by the user, recording start/end time information recorded on the presentation sequence information (Cell) to select stream object corresponding the requested time. For example, if the presentation sequence information corresponding to the requested time is Cell 1, the stream object SOB1 is selected and the time information of the mapping list MAPL1 corresponding to the selected stream object SOB1 is read. At this time, the index number INCES\_NO for indexing the specific mapping entry MAPU\_ENT or the specific coarse mapping entry C\_MAPU\_ENT recorded at the stream time map general management information STMAP\_GI is read to identify the mapping list MAPL1 corresponding to the selected stream object SOB1, and the MAPL1 is directly searched, whereby the location of the stream object units corresponding to the requested time to be reproduced or deleted is immediately searched.

### Effect Of The Invention

The method for creating and recording management information for recorded digital data streams of the present invention enables rapid and precise search of a specific interval of the recorded digital data, by searching digital data stream using identification information upon recording received digital data streams on a recording medium as groups of stream objects or deleting a part of the recorded digital data streams from the recording medium.

**What is claimed is:**

1. A method for creating and recording management information for recorded digital data streams, comprising the steps of:

    recording a received digital data stream by grouping the received digital data stream into a stream object; and

    recording identification information for identifying the location on time search information for said stream object.

2. A method set forth in claim 1, wherein said time search information is a sequential list of time lengths of stream object units in said stream object.

3. A method set forth in claim 1, wherein said identification information is an index number for indexing an entry in the time search information.

4. A method set forth in claim 1, wherein said identification information is the number of entries in the time search information for the stream object.



5. A method set forth in claim 4, wherein said identification information is additionally recorded at stream time map general management information corresponding to the stream object.

6. A method for creating and recording management information for recorded digital data streams, comprising the steps of:

deleting a part of recorded digital data stream from stream object;

dividing the stream object into a plurality of stream objects before and after the deleted part of the data stream; and

recording identification information for identifying the locations on time search information for said divided stream objects.

7. A method set forth in claim 6, wherein said deleting step deletes the stream object by stream object units, the stream object consisting of stream object units.

8. A method set forth in claim 6, wherein said identification information is an index number for in-

dexing an entry in the time search information.

9. A method set forth in claim 6, wherein said identification information is the number of entries in the time search information for the stream object

10. A method set forth in claim 6, wherein said identification information is incremental application packet time information accumulated until the divided stream objects.

11. A method for creating and recording management information, comprising the steps of:

selecting a stream object corresponding to a requested location on time for searching the requested location from recorded single program;

reading the location on time search information for searching the selected stream object; and

searching the requested location on time from recorded data stream based on start time information of the selected stream object and time length data from the read location on the time search information.

12. A method set forth in claim 10, wherein the start time information of the selected stream object

is calculated by accumulating time lengths of stream objects before the requested stream object.

13. A method for creating and recording management information for recorded digital data streams, comprising the steps of:

deleting a part of stream object units from recorded stream object of digital data stream;

selecting an entry of time search information including time lengths of the deleted stream object units; and

dividing the selected entry and updating the time search information.

14. A method set forth in claim 13, wherein said deleting step subtracts time lengths of the deleted stream object units from time length of the selected entry, and divides the subtracted time length into time lengths before and after the deleted stream object units, thereby updating the time search information using the divided time lengths.

15. A method set forth in claim 14, wherein said dividing the subtracted time length into time lengths before and after the deleted stream object units is

performed based on each time length of intervals of  
time search information included in the selected entry.

FIG. 1

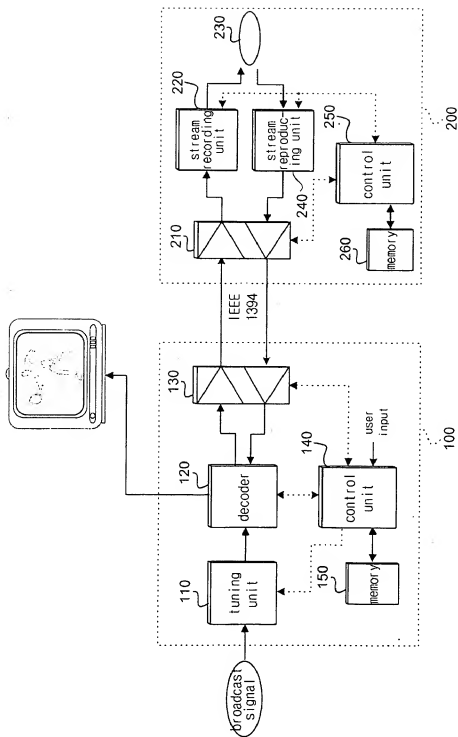


FIG. 2

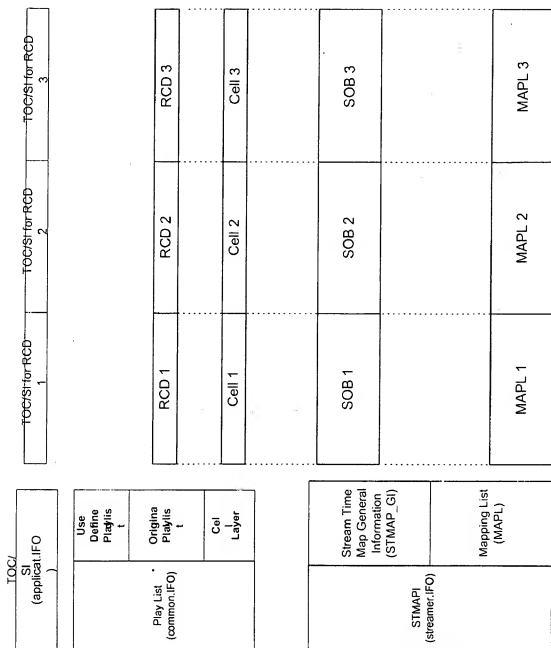


FIG. 3

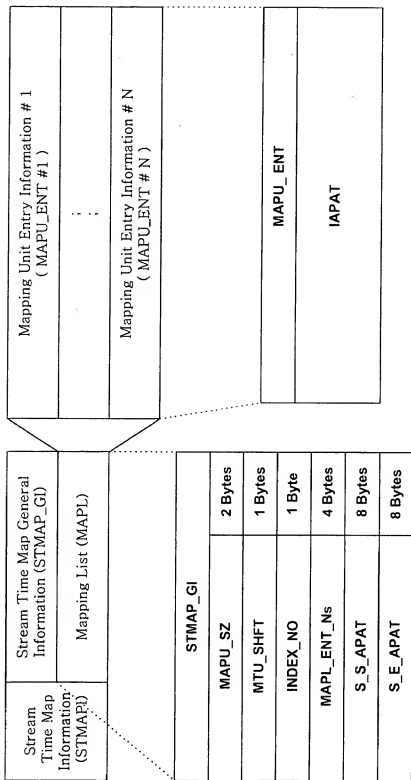


FIG. 4

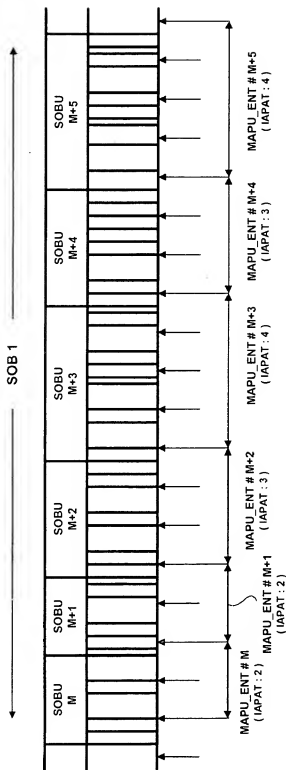




FIG. 5

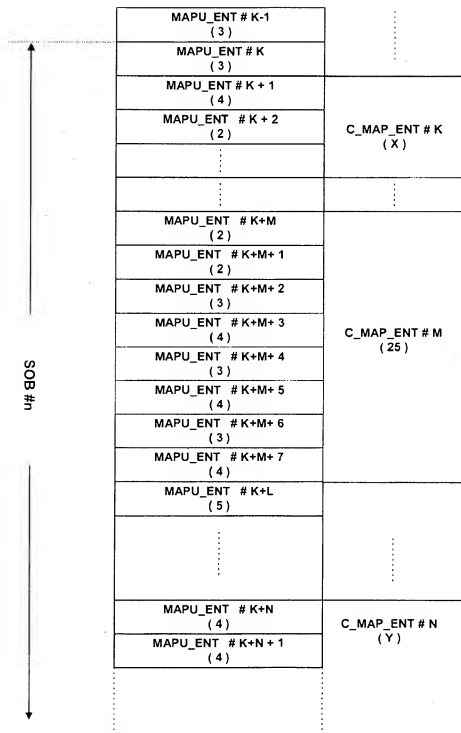




FIG. 7

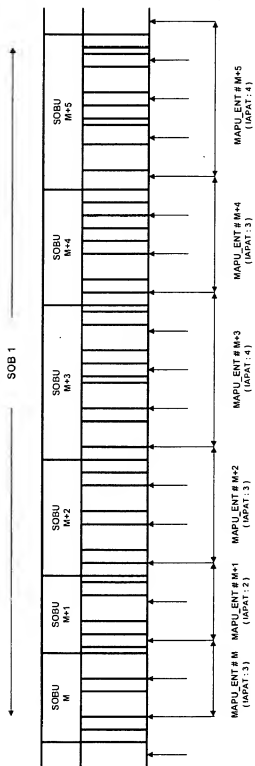


FIG. 8

